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(54) POLYASACCHARIDE-CERAMIC COMPOSITE GEL AND ITS PRODUCTION

(57)Abstract:
PURPOSE: To obtain composite gel having superior elasticity by heating an aq. dispersion contg. xanthane gum, locust beam gum and ceramic powder or granules to dissolve the gums and cooling the dispersion.
CONSTITUTION: Xanthane gum is mixed with locust beam gum is (1:9)-(9:1) weight ratio (the highest strength is attained in the case of (1:1)) and the mixture is added to a ceramic suspension contg. ≤60wt.% one or more among a potassium phosphate compd., silica, alumina, zirconia, titania and zeolite obtd. by wet synthesis or a mixture of xanthane gum with locust beam gum and ceramic powder or granules is added to cold water. The resulting aq. dispersion is heated by microwave heating or other method to uniformly dissolve the gums and the dispersion is cooled by an arbitrary method to cause gelation. Polysaccharide-ceramic composite gel having superior elasticity and uniform strength is simply obtd.

Japanese Patent Laid-Open No. H03-196834

Description

1. Title of the Invention

POLYSACCHARIDE-CERAMIC COMPOSITE GEL AND METHOD OF PRODUCING THE SAME

2. Claims

1. A polysaccharide-ceramic composite gel, wherein a ceramic powder or granule is dispersed in a gel comprised of xanthan gum and locust bean gum.

2. The polysaccharide-ceramic composite gel according to claim 1, wherein the xanthan gum and the locust bean gum are mixed in a weight ratio of 1:9 to 9:1.

3. The polysaccharide-ceramic composite gel according to claim 2, wherein the xanthan gum and the locust bean gum are mixed in a weight ratio of 1:1.

4. The polysaccharide-ceramic composite gel according to claim 1, wherein the ceramic powder or granule is dispersed in an amount of 60% by weight or less.

5. The polysaccharide-ceramic composite gel according to claim 1, wherein the ceramic is at least one selected from the group consisting of a calcium phosphate-based compound, silica, alumina, zirconia, titania and zeolite.

6. A method of producing a polysaccharide-ceramic composite gel, comprising

heating an aqueous dispersion of xanthan gum, locust bean gum and a ceramic powder or granule to dissolve the xanthan gum and the locust bean gum; and

cooling the dispersion.

3. Detailed Description of the Invention

[Application Field]

The present invention relates to a polysaccharide-ceramic composite gel useful as a culture support for large-scale cultivation of useful cells such as animal and plant cells or bacteria, which are used in biomaterials, adsorbents and substrates for chromatography and in the field of bioindustry, for example, and a method of producing the same.

[Prior Art and Problems Thereof]

Since a calcium phosphate-based compound including hydroxyapatite is a main inorganic component of biological hard tissues, application of the compound to artificial dental roots, bone prostheses or the like has been studied, and several types are now commercially available, and clinical application thereof is frequently carried out. However, the commercially available bone prostheses are produced by sintering, and they have high mechanical strength, but are not satisfactory with respect to workability and elasticity. As products in which these defects are overcome, Japanese Patent Laid-Open No. S62-176454 discloses a bone-like molded product prepared by reacting hydroxyapatite, glycosaminoglycan, glucomannan and epihalohydrin. However, the bone-like molded product is produced using an alkali and epihalohydrin, which have harmful effects on a human body, and

therefore it takes a long time to remove these materials by washing.

In addition, in Japanese Patent Application No. H01-118244, the inventor proposed, as the material having no harmful effects on a human body, a polysaccharide-calcium phosphate composite gel comprised of a gelling agent which is at least one polysaccharides selected from carrageenan, furcellaran, a low-methoxylated pectin and gellan gum, and a solid calcium phosphate having a Ca/P ratio of 1.5 to 1.9. Although the composite gel has a higher elasticity than a sintered product of calcium phosphate, the gel may not have adequate elasticity as a material for soft tissues, which are mainly used in orthopedics, such as artificial noses, artificial pinnae and artificial breasts.

[Objectives of the Invention]

It is an object of the present invention to provide a polysaccharide-ceramic composite gel which can be easily produced, and has uniform strength and excellent elasticity, in particular.

[Configuration of the Invention]

The polysaccharide-ceramic composite gel according to the present invention is characterized in that a ceramic powder or granule is dispersed in a gel comprised of xanthan gum and locust bean gum.

It is known that xanthan gum and locust bean gum are polysaccharides which are not gelled alone, but they are gelled when both of them are mixed (Mitsubishi Acetate Co., Ltd., "Soageena, Soalocust TECHNICAL INFORMATION", p. 27). In the

present invention, xanthan gum and locust bean gum are mixed in a weight ratio of 1:9 to 9:1. When xanthan gum and locust bean gum are mixed in a weight ratio of 1:1, a gel having a maximum strength may be obtained. When the ratio between xanthan gum and locust bean gum is not within the above range, the gel may be brittle. Therefore, it is not desirable.

In the present invention, although only xanthan gum and locust bean gum may be used as gelling agents, other gelling agents such as carrageenan and gellan gum, may also be added as additives in some cases.

In the present invention, at least one selected from the group consisting of a calcium phosphate-based compound, silica, alumina, zirconia, titania and zeolite may be used as the ceramic. If the composite gel of the present invention is used as a biological material, preferred is a calcium phosphate-based compound having a Ca/P ratio of 1.5 to 1.9, for example, apatites such as hydroxyapatite and tricalcium phosphate, from the viewpoint of biological affinity and the like.

In the present invention, the ceramic as described above may be used in the form of powder or granule. A suspension obtained by a wet process may be used without any treatment. Alternatively, a granule which is obtained by drying the suspension, granulating and then subjecting to heat treatment such as calcinations, if necessary, by any known method may be used.

The content of the ceramic powder or granule in the gel may be appropriately selected depending on the application of the composite gel. However, a gel cannot be obtained when the

content exceeds 60% by weight, and thus the content must be 60% by weight or less.

The composite gel according to the present invention may be produced by heating an aqueous dispersion of xanthan gum, locust bean gum and a ceramic powder or granule to dissolve the xanthan gum and the locust bean gum; and then cooling the dispersion.

The aqueous dispersion of xanthan gum, locust bean gum and a ceramic powder or granule, which is used as a starting material, may be one obtained by a wet process, which is prepared by adding xanthan gum and locust bean gum into a suspension of a ceramic; or alternatively, by adding a mixture of xanthan gum, locust bean gum and a ceramic powder or granule into cold water followed by dispersion. If necessary, other gelling agents may be added. An aqueous dispersion thus obtained is heated to dissolve xanthan gum and locust bean gum. Although the heating method is not particularly limited, microwave heating using a microwave oven is preferable because it is the easiest way and a homogeneous solution can be obtained in a short time.

After heating the dispersion and dissolving xanthan gum and locust bean gum, the dispersion is cooled by any known cooling method, for example, by standing to cool, water-cooling and cooling in a refrigerator or a freezer, to obtain the polysaccharide-ceramic composite gel of the present invention.

[Examples of the Invention]

Now, the present invention will be described in more detail with reference to the Examples. However, the present invention is not limited to these Examples.

The xanthan gum used in the following Examples is one which is commercially available under the trade name of Soaxan from Mitsubishi Acetate Co., Ltd. and the locust bean gum used in the following Examples is one which is commercially available under the trade name of Soalocust from Mitsubishi Acetate Co., Ltd.

Example 1

A hydroxyapatite suspension was prepared by reacting an aqueous solution of phosphoric acid and an aqueous suspension of calcium hydroxide by a known method. The suspension was spray-dried to obtain a hydroxyapatite powder. A dispersion was prepared by dispersing 10 g of the hydroxyapatite powder, 1 g of xanthan gum, and 1 g of locust bean gum in 100 g of water. The dispersion was heated in a microwave oven for 10 minutes, and then cooled in a freezer for 5 minutes, to obtain a composite gel. The content of the hydroxyapatite in the gel was 15%.

Example 2

A composite gel was obtained in the same manner as in Example 1, except that 90 g of zirconia powder (trade name: TZ-3Y; produced by Toso Co., Ltd.) was used instead of hydroxyapatite. The content of zirconia in the gel was 55%.

Example 3

A dispersion was prepared by dispersing 6 g of an alumina powder (trade name: Taimicron; produced by Taimei Chemicals Co., Ltd.), 0.7 g of xanthan gum, and 0.3 g of locust bean gum in 50 g of water. The dispersion was heated in a microwave oven for 5 minutes, and then cooled in a freezer for 5 minutes, to obtain a composite gel having an alumina content of 15%.

Example 4

A composite gel having a hydroxyapatite content of 25% was obtained in the same manner as in Example 3, except that 10 g of a hydroxyapatite granule (Apaceram G, produced by Asahi Optical Co., Ltd.), 0.3 g of xanthan gum, and 0.7 g of locust bean gum were used.

Example 5

A dispersion was prepared by dispersing 6 g of the alumina powder used in Example 3, 0.1 g of xanthan gum, and 0.9 g of locust bean gum in 50 g of water. The dispersion was heated in a hot water bath at the boiling temperature for 15 minutes, and then cooled in a freezer for 5 minutes, to obtain a composite gel having an alumina content of 11%.

[Advantages of the Invention]

The composite gel according to the present invention can be easily produced in a short time. The composite gel has no harmful effects on a human body, and has high strength and excellent elasticity.

Therefore, the composite gel of the present invention is useful as various biological materials such as a prosthesis including an artificial nose, an artificial pinna and an artificial breast, a transdermal element, and a cartilage prosthesis associated with bones or joints; a cell culture support; and a substrate for chromatography.